REMARKS

File History

In the latest substantive Office action of 03/15/2005, the following allowances, rejections, objections and other actions appear to have been made:

> Claims 1-3, 10, 12-21, 24-25 were rejected under 35 USC §103(a) as being obvious over Lin (US 6,127,227) as combined with Misium (US 6,261,973) and further combined with George [sic] (US 6,140,024).

> Claim 11 was rejected under 35 USC §103(a) as being obvious over Lin , Misium '973, George and in further view of Zheng (US 6,653,199).

> Claims 22-23 were rejected under 35 USC §103(a) as being obvious over Lin , Misium '973, George and in further view of Hagiwara (US 5,847,427).

> A characterization was made of the specification as containing no disclosure of any criticality or unexpected results. (OA page 5, paragraph 9 --re claim 12.)

Summary of Current Response

No claims are amended.

Arguments are presented concerning the applied art and its proposed combination and/or modification.

Applicants' Overview of Outstanding Office Action

Applicant sees the outstanding Office action (OA) of 03/15/2005 as having the following major features:

(1) A first *finding of fact* is made that Misium '973 teaches at col. 2, lines 1-3 that RPN ... **can** be used for creating **Lin's nitrided layer**. (OA pg. 3, bottom three lines, emphasis added).

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(2) A second *finding of fact* is made that George (actually it is Misium again) teaches at col. 5, lines 62-67 that RPN ... may be used to protect the silicon **surface** of Lin's first conductive layer (OA pg. 4, 2nd paragraph, emphasis added).

(3) Based on the above first and second *findings of fact* (1)-(2), a conclusion is reached that it would have been obvious at the time of invention for an ordinary artisan to nitride Lin's first conductive layer by RPN, as suggested by Misium '973 and George (Misium) '024, the motivation of the ordinary artisan for doing so being "to lower the thermal budget of the process and improve device reliability" (OA pg. 4, 3rd paragraph, emphasis added).

(4) There is no discussion in the Office action (OA) regarding the "evidence" of nonobviousness which Applicant submitted with the Preliminary Amendment of 1/30/2004, namely, Crivelli 2003-0183869. There is no discussion regarding the technical differences pointed out in the Remarks of the Preliminary Amendment of 1/30/2004, namely, those between "punch through" nitridation and "surface" nitridation. Instead, a summary judgment appears to have been reached that all nitridations look alike to an ordinary artisan *at the time of invention* and therefore each of RPN, DPN and punch-through ion implantation are equivalent with one another and easily interchanged with one another for all purposes.

(5) No objective evidence of motivation to combine or modify was provided. Instead, self-conflicting speculations were provided about wanting to simultaneously reduce mechanical stress "during high temperature processing" (OA pg. 4, top paragraph) and wanting "to lower the thermal budget" (OA pg. 4, 3rd paragraph). How can one worry about mechanical stress in "high temperature processing" and strive for a "lower thermal budget" in the same train of thought? If the budget is low, there should be no high temperature processing. See Crivelli 2003-0183869.

(6) The PTO asserted that recital of a given concentration of nitrogen atoms (1-20%) in the "nitrided surface" (Claim 12) is inherently and prima facie obvious because the ordinary artisan "would have been able to determine [such values] using routine experimentation" (Office action, page 5, second paragraph).

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It will be shown in more detail below that:

(A) The first and second *findings of fact* (1)-(2) are clearly erroneous;

(B) The stated motivation for replacing ion implant of nitrogen with RPN or DPN fails to account for an intermediate structure (Lin Fig. 2B) which must be created in accordance with the teachings of Lin '227 and which RPN or DPN will not provide;

(C) The MPEP requires that all evidence and arguments of record must be considered during each round of examinations and "reasons" must be provided for why evidence and arguments are insufficient to overcome corresponding rejections. See MPEP §2144.08(III) ("should rest on all the evidence").

(D) The relied on holding of *In re Woodruff* 16 USPQ2d 1934 is taken out of context. Applicants do not have to establish criticality until after the PTO has found art with subsuming or fully overlapping ranges. (In *Woodruff*, the PTO had found a McGill reference which provided overlap for every one of the ranges recited in the applicant's claims. See the chart at 16 USPQ2d 1935.) (The Board must consider all of the applicant's evidence. In re Rouffet, 149 F.3d 1350; 47 USPQ.2d 1453 (Fed. Cir. 1998) ... While this court reviews the Board's determination in light of the entire record, an applicant may specifically challenge an obviousness rejection by showing that the Board reached an incorrect conclusion of obviousness or that the Board based its obviousness determination on incorrect factual predicates.

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A Closer Look at the Lin reference

A closer look is taken at the details of the primary reference, Lin '227. The critical language of contention appears at col. 4, lines 39-57 of Lin which language is reproduced below with emphasis added:

> As a main feature and key aspect of this [Lin's] invention, the polysilicon layer is then subjected to nitrogen treatment as shown in FIG. 2b. The nitrogen treatment is accomplished at a pressure between about 400 to 600 millitorr (mT). In a second embodiment, the first polysilicon **layer** is subjected to **ion implantation** at a dosage level between about $1\text{x}10^{12}$ to $5\text{x}10^{14}$ atoms/cm^2 **at an energy between about 5 to 30 KeV.** It will be appreciated that the **presence of nitrogen**, shown **as** phantom dots (125) in FIG. 2b, **in** the upper layers of polysilicon (120) will suppress the oxidation rate of polysilicon, thereby providing an enhanced control of the thickness of the bottom oxide of the ONO composite that is to be formed next over the first polysilicon layer. In essence, the thickness of the bottom oxide of the ONO layer to be formed is controlled by still another very thin layer formed through the combination of the nitrogen introduced **into** the first polysilicon layer with silicon and the oxidizing oxygen of the next step. This additional thin layer thus forms an augmented ONO layer.
>
> [Underlining and other emphasis added.]

Note that Lin never mentions anything about using a surface nitriding process or about nitriding a surface of the first polysilicon layer in the above reproduced copy of col. 4, lines 39-57. Instead, Lin speaks only about first polysilicon layer and about creating a presence of nitrogen atoms at the depth indicated by dashed lines 125 of Fig. 2B. Lin unequivocally states that "the **presence of nitrogen** [is] shown **as** phantom dots (125) in FIG. 2b" at col. 4, lines 46-47. Dashed line 125 is buried well below the top surface of layer 120. In fact, a computer search of the text of Lin '227 shows that the word "surface" appears only 3 times in Lin, namely, only at col. 2, lines 44-65 where Lin describes Kwong '436 and Ellul '081. Clearly, Lin was facile with the use of the word "surface" and intentionally chose not to use that word when describing his "key" nitrogen treatment step at col. 4, line 40.

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The reason why Lin avoided mentioning the surface of layer 120 in the text of col. 4, lines 39-57 would have been very clear to one of ordinary skill at the relevant time. The ion implantation technique that Lin '227 expressly teaches, "implants" the ions (nitrogen) at a given depth below the surface, the depth being governed by the energy used (5 to 30 KeV) to implant the ions. This is why Lin '227 shows the presence of implanted nitrogen as dashed lines 125 buried below the top surface of polysilicon layer 120. The nitrogen is placed underground so-to speak, under the surface. Ordinary definitions of the term, "implant" include: to become attached to and embedded <u>inside</u> of something, i.e.; "The in-vitro fertilized egg was implanted in the uterus of the birth mother." Lin does not provide an alternate definition for the ordinary one associated with "implant". It means inside. Use of the words "in" and "into", as highlighted in the above reproduction of Lin col. 4, lines 39-57 reinforce this industry understood meaning of "implantation".

Within the next paragraph of Lin, which corresponds to Fig. 2C, there is discussion of the so-called, "unusually thin augmented layer (130)" that is shown as a darkened line replacing the buried dashed line 125 of Fig. 2B. There is also discussion regarding the "bottom oxide layer (143)" which is drawn in Fig. 2C as a white filled layer replacing that portion of polysilicon 120 of Fig. 2B that was disposed above the buried dashed line 125. More specifically, the next paragraph defined by col. 4, line 58- col. 5, line 10 states in part:

> Thus, the bottom <u>oxide layer (143)</u> in FIG. 2c ... is next formed by first subjecting the nitrogen rich first polysilicon layer to oxidation, preferably at a temperature between about 700 to 1050°C. However, <u>at the same that the bottom oxide layer is</u> <u>**grown**</u>, still another, but an unusually thin augmented layer <u>(130) is formed having a composition of nitrogen, oxygen and silicon</u> (N--O--Si). The thickness of the N--O--Si layer is only between about 5 to 10Å, while <u>the overlying bottom oxide</u> assumes a <u>thickness of between about **40** and 120Å</u>. It will be apparent to those skilled in the art that ... uniform thickness of the bottom oxide layer (143) ... then makes it possible to attain the precise coupling ratio ... for the accurate performance of the memory cell. Also, while nitrogen <u>**in**</u> the first polysilicon slows down the <u>**polysilicon oxide growth**</u> ... it suppresses the gradual gate oxidation (GGO) effect ....

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[Ellipses ... inserted in place of superfluous text, underlining and other emphasis added]

The above emphasized parts of col. 4, line 58- col. 5, line 10 in combination with Fig. 2C of Lin clarify a few important points for one of ordinary skill. First, the ordinary artisan would note that immediately below the dark thick, S--O--N line 130 there is shown the hatching representing polysilicon 120. Thus Lin teaches that the concentration of nitrogen in his S--O--N augmented layer 130 is sufficient to block oxidation below line 130. Second, the ordinary artisan would observe, that in Fig. 2B, a sublayer of nitrogen-free silicon is present, above dashed line 125, and it is there for the purpose of supplying the silicon atoms that will form the nitrogen-free silicon oxide layer 143 of Fig. 2C when the structure of Fig. 2B is exposed to the 700 to 1050°C oxidizing environment. Otherwise, Lin would not refer to layer 143 as being the "grown" "bottom oxide layer" whose composition is distinguished from the special "composition of nitrogen, oxygen and silicon (N--O--Si)" that defines the "augmented layer (130)". Next, because the nitrogen-free region 143 is described as having a thickness between about 40 and 120Å, it is clear that there was a nitrogen-free region of comparable thickness above dashed line 125 of Fig. 2B --the point being that the surface of polysilicon layer 120 of Lin Fig. 2B was free of nitrogen. There was no surface nitridation. Also the comparable thickness above dashed line 125 was free of nitrogen. There was no nirtridation extending from the surface to a given depth below the surface.

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A Closer Look at the Misium '973 reference

With the structures of Lin's Figs. 2B-2C now in mind, we next look at Misium '973. The PTO correctly finds that Misium '973 includes the acronym "RPN" (actually it appears at col. 4, line 26). Based on this, the PTO asserted that: Misium '973 teaches at col. 2, lines 1-3 [sic] that RPN ... can be used for creating **Lin's nitrided layer**. (OA pg. 3, bottom three lines, emphasis added). By this, the PTO clearly meant to say: Lin's *buried* S--O--N layer 130.

Looking at the relevant Figs. 3B-3C of Misium '973, one does not see anything resembling the buried "augmented layer (130)" of Lin '227. Instead, one sees a wafer 10 on which a silicon dioxide layer 12 had been formed (col. 3, lines 52-53) by a high temperature oxidizing step and then patterned together with an overlying polysilicon layer 30 above to define a gate oxide and a gate, respectively (col. 4, line 21). Next, a silicon oxide layer was blanket deposited and etched back to form silicon dioxide sidewalls 32, as shown in FIG. 3B, leaving the wafer's silicon surface exposed again. Finally, in Fig. 3C a surface covering nitride layer 22 is created by exposing the wafer 10 to RPN (col. 4, line 26). There is absolutely no teaching or suggestion in Misium '973 that the surface covering nitride layer 22 can instead be formed as a *buried* nitride layer by use of RPN. There is absolutely no teaching or suggestion in Misium '973 to form the buried and "unusually thin augmented layer (130)" of Lin '227.

Thus the first *finding of fact* on which all the outstanding grounds of rejection are predicated --see item (1) in the above Applicants' Overview of Outstanding Office Action-- is not only unsupported, but contradicted by what Misium '973 actually teaches. Not only does Misium '973 fail to teach or suggest the formation via RPN of a *buried* and "unusually thin augmented layer (130)" as required by Lin '227, Misium '973 also fails to provide any reasonable basis by which an ordinary artisan would be motivated to combine Lin '227 with

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the teachings of Misium '973 or vise versa. Misium '973 fails to teach or suggest that RPN can be used to form a *buried* nitride layer. Thus, the assertion made by the PTO that RPN "can" be used for creating Lin's buried and "unusually thin augmented layer (130)" is based completely on speculation and has no basis in evidence or fact. It is clearly erroneous and should be rescinded.

<u>A Closer Look at the George (aka Misium) '024 reference</u>

With the structures of Lin's Figs. 2B-2C still in mind, we next look at George '024. Figs. 3A-3B of George '024 roughly correspond to 3B and 3C of Misium '973 except that it is the surface of a silicon <u>oxide</u> layer 12 that is <u>being nitridated</u> by RPN in George '024 rather than a silicon wafer surface. Actually, "George" is Misium's first name. The goal of George (aka Misium) '024 is the same as that of Misium '973, namely, to create an etch stop layer 22. Once again, George (aka Misium) '024 nowhere teaches or suggests that the surface covering nitride layer 22 can instead be formed as a *buried* nitride layer implanted inside of a polysilicon layer by use of RPN. There is absolutely no teaching or suggestion in George (aka Misium) '024 to form the buried and "unusually thin augmented layer (130)" of Lin '227. While it is true the col. 5, lines 63-67 briefly mention use of RPN for additional layers such as polysilicon, the goal is that of providing surface protection during a subsequent etching process. It has nothing to do with forming an ONO structure.

Thus the second *finding of fact* on which the outstanding grounds of rejection are predicated --see item (2) in the above Applicants' Overview of Outstanding Office Action-- is not only unsupported, but contradicted by what George (aka Misium) '024 actually teaches. Not only does George (aka Misium) '024 fail to teach or suggest the formation via RPN of a *buried* and "unusually thin augmented layer (130)" as required by Lin '227, George (aka

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Misium) '024 also fails to provide any reasonable basis by which an ordinary artisan would be motivated to combine Lin '227 with the teachings of George (aka Misium) '024 or vise versa; particularly because George (aka Misium) '024 is mostly directed to nitridating an oxide layer rather than a silicon layer and the whole purpose is to form an etch stop. The assertion by the PTO that George (aka Misium) '024 provides additional motivation and enablement showing that RPN "may" be used for creating Lin's buried and "unusually thin augmented layer (130)" is based completely on speculation and has no basis in evidence. Speculative possibilities such as "may" and "can" are not interchangeable with the motivational "should" that is required under obviousness analysis.

A Brief Look at the other claims

Without George '024 or Misium '973 or a valid basis for combining these with Lin '227, all the outstanding grounds of rejection collapse. See for example, *In re Rouffet*, 149 F.3d 1350; 47 USPQ.2d 1453 (Fed. Cir. 1998) which among other things, notes that "an Applicant may specifically challenge an obviousness rejection by showing that the [PTO] .... based its obviousness determination on incorrect factual predicates." (emphasis added).

Nonetheless, we briefly look at the outstanding grounds of rejection raised against some of the dependent claims to point out serious errors of fact finding made therein as well. With regard to Claim 2, (and see also re paragraph (c) of Claim 1), the outstanding Office action fails to appreciate that Lin '227 teaches to provide *nitrogen-free* silicon in the polysilicon sublayer above dashed line 125 (Fig. 2A). This *nitrogen-free* silicon sublayer serves as the source of the silicon atoms that are going to be oxidized by the high temperature oxidizing environment. Silicon nitride retards thermal oxidation. Clearly, because there is no

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oxide shown below line 130 in Lin's Fig. 2B, Lin is teaching to use a sufficient nitrogen implant does to prevent oxide growth below line 130.

That should raise a question here. Given that paragraph (b) of Claim 1 of the present application recites "nitriding a silicon-containing surface of the first layer", where do the silicon atoms come from to enable the thermal oxidizing step of paragraph (c) of Claim 1? Does not SiN retard oxidation? The answer is that the to-be-oxidized silicon atoms (Si) come from the nitrided surface region. Surface nitriding does not necessarily bind all the silicon atoms in the nitrided surface region to nitrogen (N) or block them all from combining with energetic oxygen. This is something that Lin '227 neither teaches nor suggests. In fact, Lin suggests quite the opposite, that the *buried* SiN layer 125 will function as an oxidation stop and will not allow creation of oxide below line 130. The outstanding grounds of rejection against present Claim 2 fail to account for any of this. The outstanding grounds of rejection fail to consider the subject matter of Claim 2 in whole.

With regard to Claim 3, the outstanding grounds of rejection acknowledge that Lin '227 requires a "surface" composed of polysilicon. The Office action fails however, to account for the rest of Lin '227 which requires the "unusually thin augmented layer (130)" to be *buried* a finite distance under the surface thereby leaving nitrogen-free polysilicon above dashed line 125.

With regard to Claim 10, although it is true that Misium '973 uses RPN, a reference must be read in whole for what it fairly teaches to one of ordinary skill. Misium '973 teaches that the RPN is to be used only for nitriding a "surface" and only for the purpose of forming an etch stop.

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With regard to Claim 12, the PTO relies on *In re Aller* and *In re Woodruff* to make the erroneous assertion that an Applicant is always required to demonstrate criticality when setting forth a range. This is truly putting the cart before the horse. In *In re Aller* 105 USPQ 233, the PTO **first** found a prior art reference (Heinrich et al) which according to the PTO, taught a process "identical" to that claimed by the Applicants except that the temperatures and sulfuric acid concentrations were slightly different. The PTO made a finding of fact that the changes needed to modify the Heinrich et al reference, so as to exactly replicate Applicants claims, were minor and obvious ones.

The same predicate holds true for *In re Woodruff* 16 USPQ2d 1934. *Woodruff* does not stand for the proposition that an Applicant must *always* show criticality. Applicants do not have to establish criticality until after the PTO has found art with subsuming or fully overlapping ranges. In *Woodruff*, the PTO had found a McGill reference which provided overlap for every one of the ranges recited in the applicant's claims. See the chart provided by the court at 16 USPQ2d 1935. Only at that point where the PTO had demonstrated complete overlap of ranges did the burden shift to the Applicant to submit rebuttal evidence of unexpected results.

The discussion of case law here, may lead the Examiner into missing the iceberg that sank the Titanic. The specific concentration of nitrogen recited in Claim 12 is irrelevant because Lin '227 teaches to have zero --no concentration-- of nitrogen at the top surface of his polysilicon layer 120. Lin teaches to fully bury the nitrogen. Thus, Lin teaches away!!

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With regard to Claim 13, the Office action makes the essentially same mistake. Lin teaches to fully bury the nitrogen. Thus there cannot be surface nitrogen extending via surface nitriding to no more than a given depth.

With regard to independent Claim 18, its paragraph (c) recites "(c) surface nitridating said top surface of the floating gate layer" (emphasis added). It has been demonstrated above by clear and convincing evidence that Lin '227 teaches away from surface nitridating. Col. 4, lines 39-46 do not in any reasonable way suggest that nitrogen atoms should be incorporated into the surface of the polysilicon layer 120. Dashed line 125 is clearly *buried* below the surface.

With regard to Claims 20 and 24, the Office action asserts that line 125 of Lin '227 represents a nitrided top surface (OA page 8, paragraph 17). This is clear error. Dashed line 125 represents the buried depth at which the implanted nitrogen ions are present.

MPEP §2144.08(III)

Applicant identifies MPEP §2144.08(III) above as just one example of an overreaching requirement placed on the PTO during examination. The Examiner is required to consider the entire record when examining claims and to provide reasons for rejections. This, is necessary because of the possibility of appeal to the Board of Appeals. In order to review a case, the Board requires full appreciation of the Examiner's response to all rebuttal arguments and rebuttal evidence which the Applicant has placed on record. Similarly, if appeal continues up to the Federal Circuit, appellate review must be of the entire administrative record created by the PTO (an administrative agency subject to the Administrative Procedure Act (APA)).

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Given that all outstanding rejections are founded on the above-identified, incorrect readings of Lin '227, Misium '973 and George '024, they should all be withdrawn at least for that reason alone.

CONCLUSION

In light of the foregoing, Applicant respectfully requests that the rejections be withdrawn. Should any other action be contemplated by the Examiner, it is respectfully requested that he contacts the undersigned at (408) 392-9250 to discuss the application.

The Commissioner is authorized to charge any underpayment or credit any overpayment to Deposit Account No. 50-2257 for any matter in connection with this response, including any fee for extension of time and/or fee for additional claims, which may be required.

I hereby certify that this correspondence is being deposited with the United States Postal Service as First Class Mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on 4-14, 2005.

4/13/2005

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